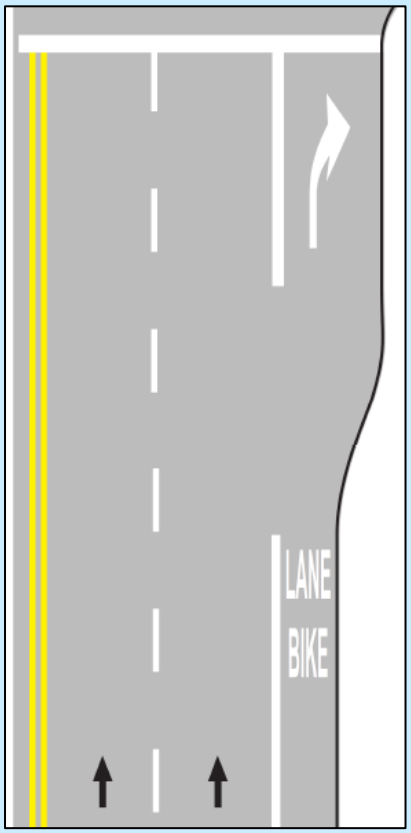
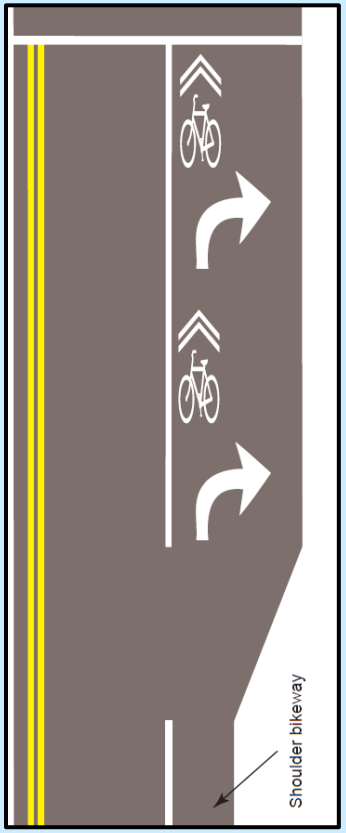
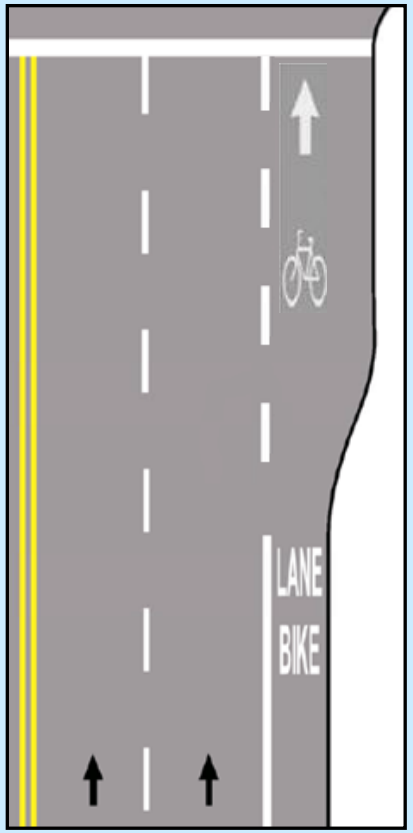
Rethinking Bike Lane Design Standards:
The Importance of an Operating Concept

Helen "Maggie" O'Mara, P.E.







Rethinking Bike Lane Design Standards

A. Bike lane crashes we can minimize with an Operating Concept for design

B. Why AASHTO *Bike Guide* and MUTCD bike lane guidance doesn't minimize crashes

C. Bike lane designs that reflect bike lane Operating Concept

A. Bike Lane Crashes We Can Minimize

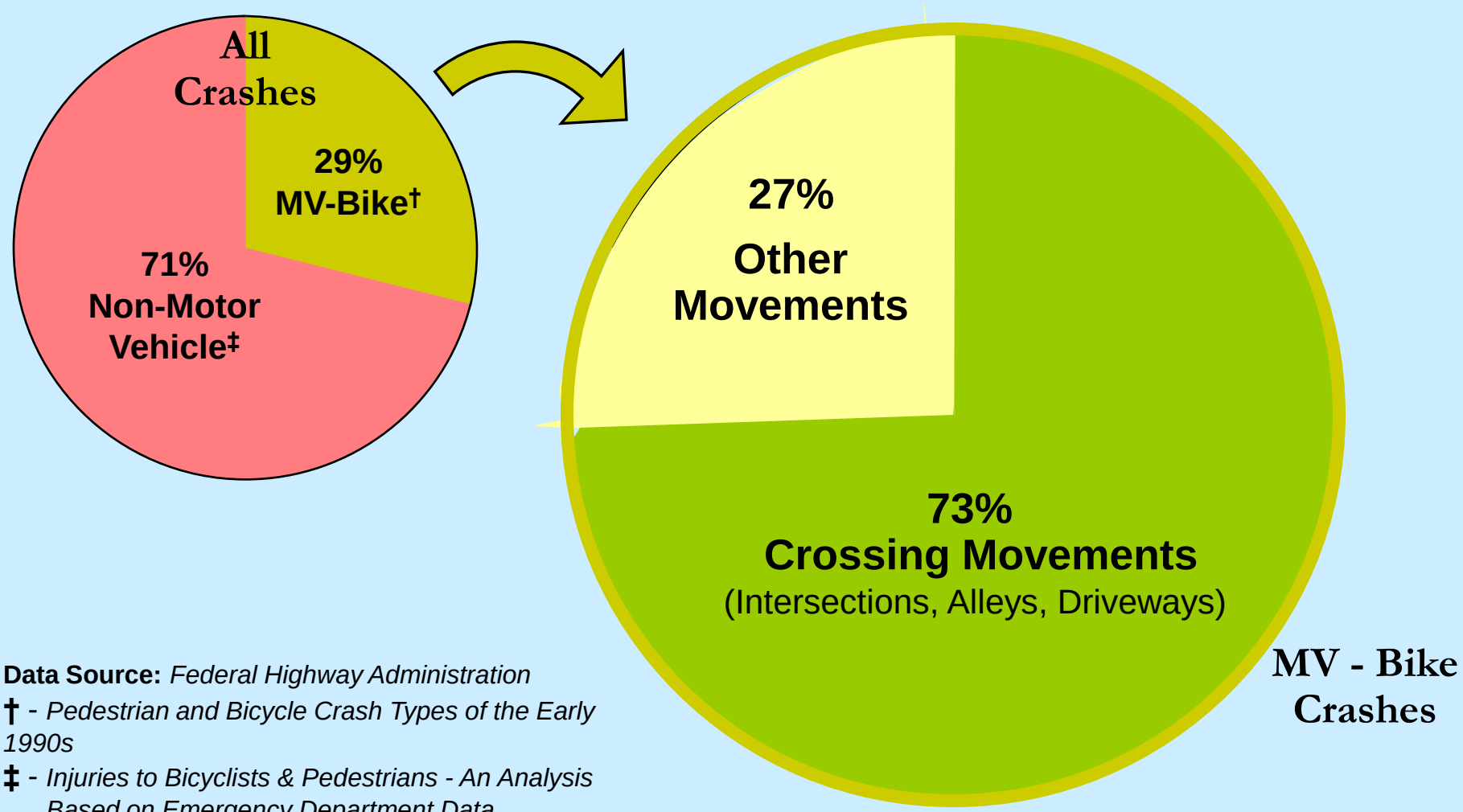
1) **Right Hook – Right turning drivers collide with through bicyclists**

2) **Left Cross – Left turning drivers collide with oncoming bicyclists**

3) **Drive Out – Driver exits driveway/alley without yielding**

4) **Dooring – Vehicle occupant opens door into bicyclist without yielding**

How Bike Crashes On Roads Occur



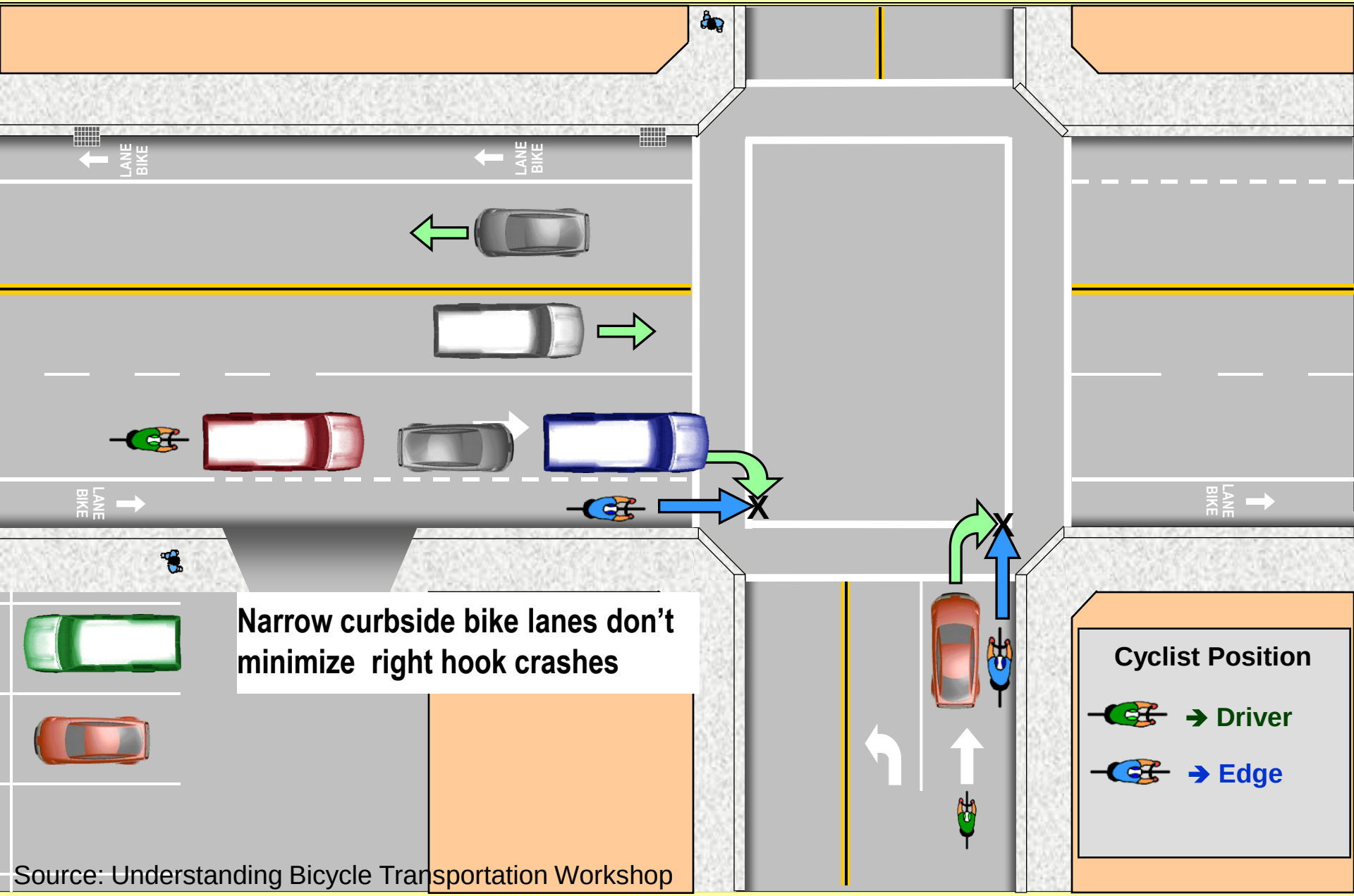
Data Source: *Federal Highway Administration*

† - *Pedestrian and Bicycle Crash Types of the Early 1990s*

‡ - *Injuries to Bicyclists & Pedestrians - An Analysis Based on Emergency Department Data*

73% of car-bike crashes are due to crossing movements

1. Right Hook Crash Risk vs Road Position

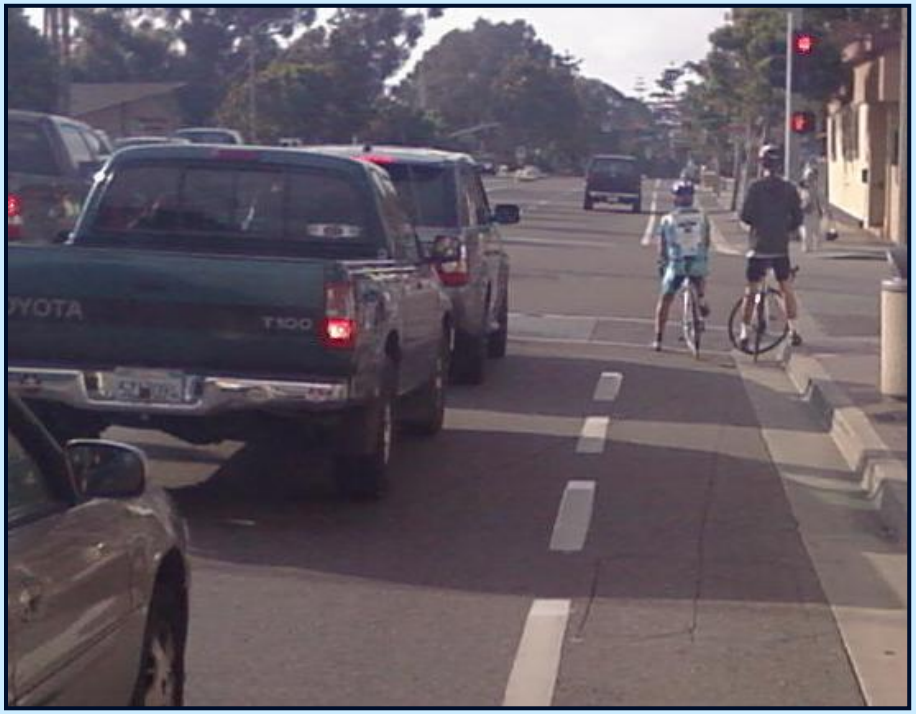


Source: Understanding Bicycle Transportation Workshop

Two Elements of Right Hook Crashes

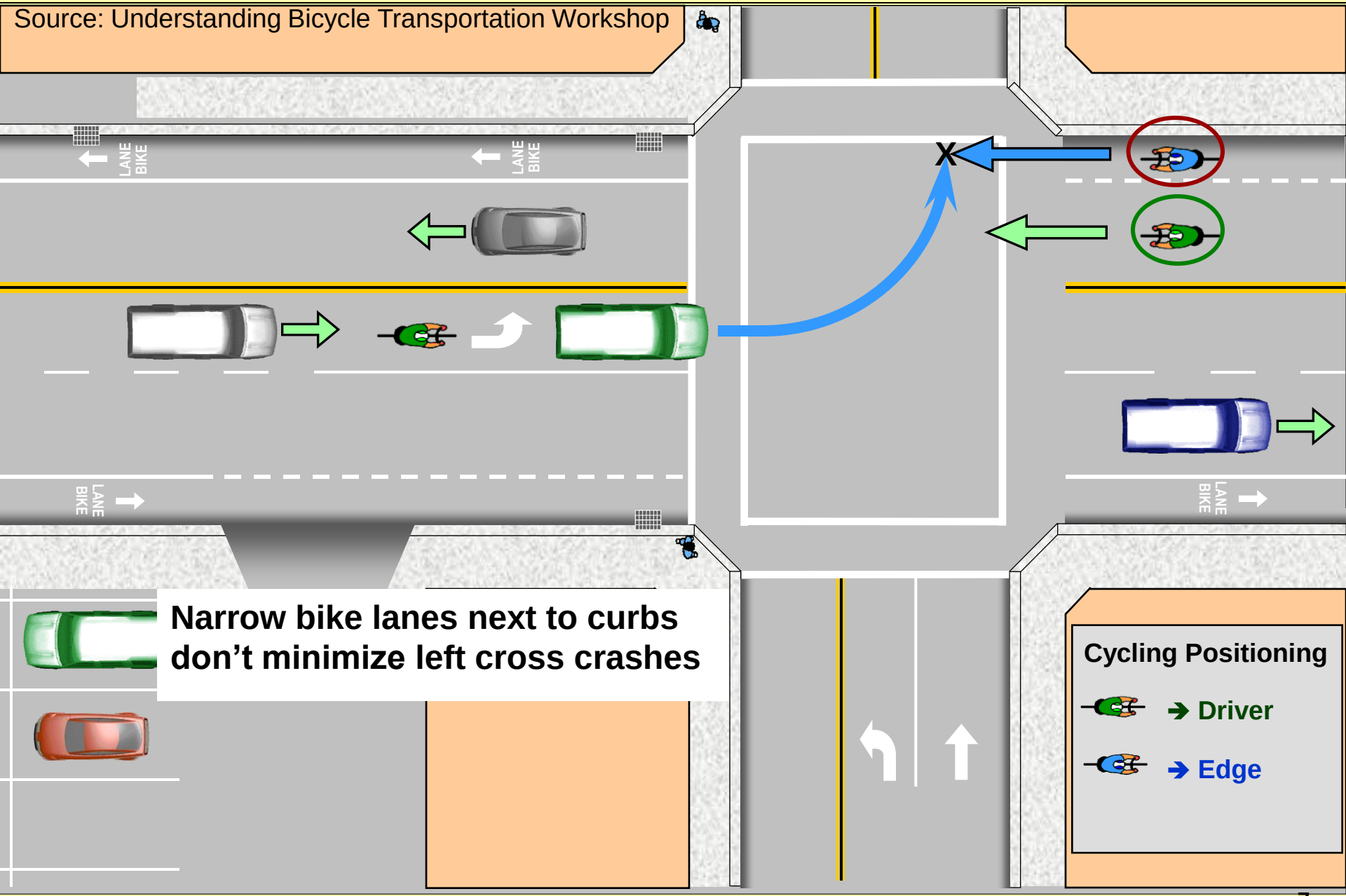
Source: Understanding Bicycle Transportation Workshop

Motorists fail to merge into narrow bike lane before right turn

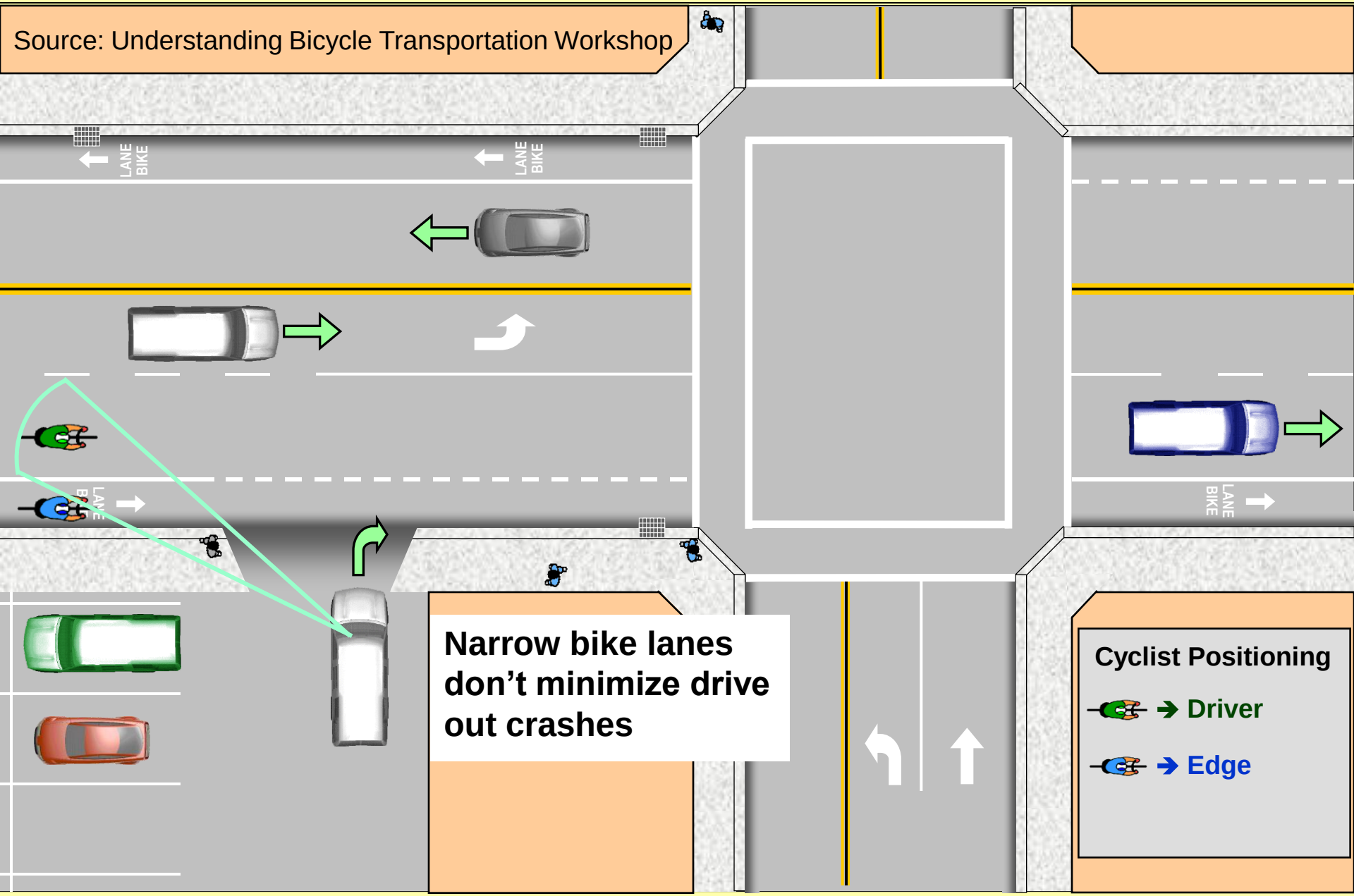


Cyclists in bike lane stay at edge at intersection

2. Left Cross Crash Risk vs Road Position

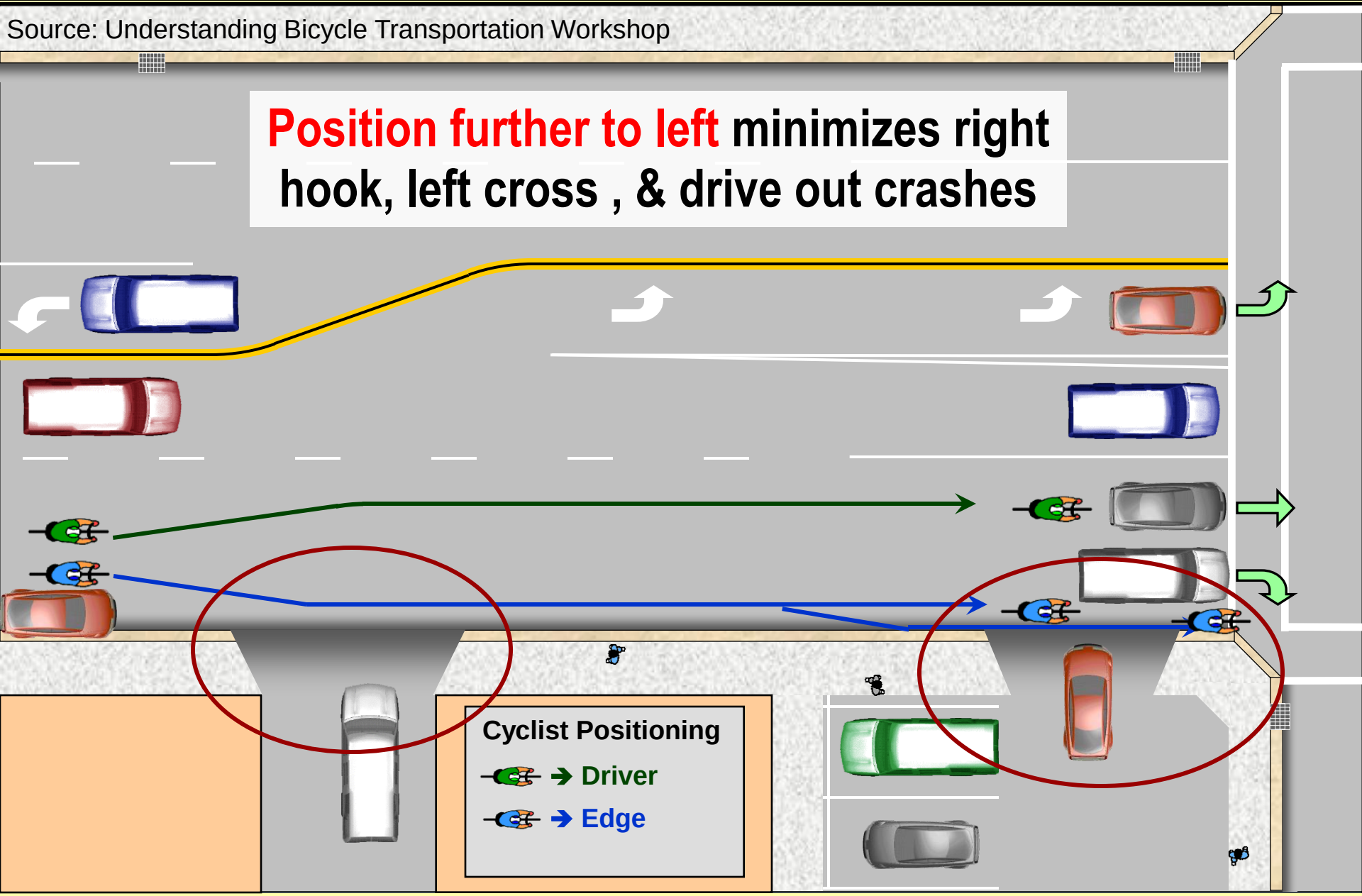


3. Drive Out Crash Risk vs Road Position

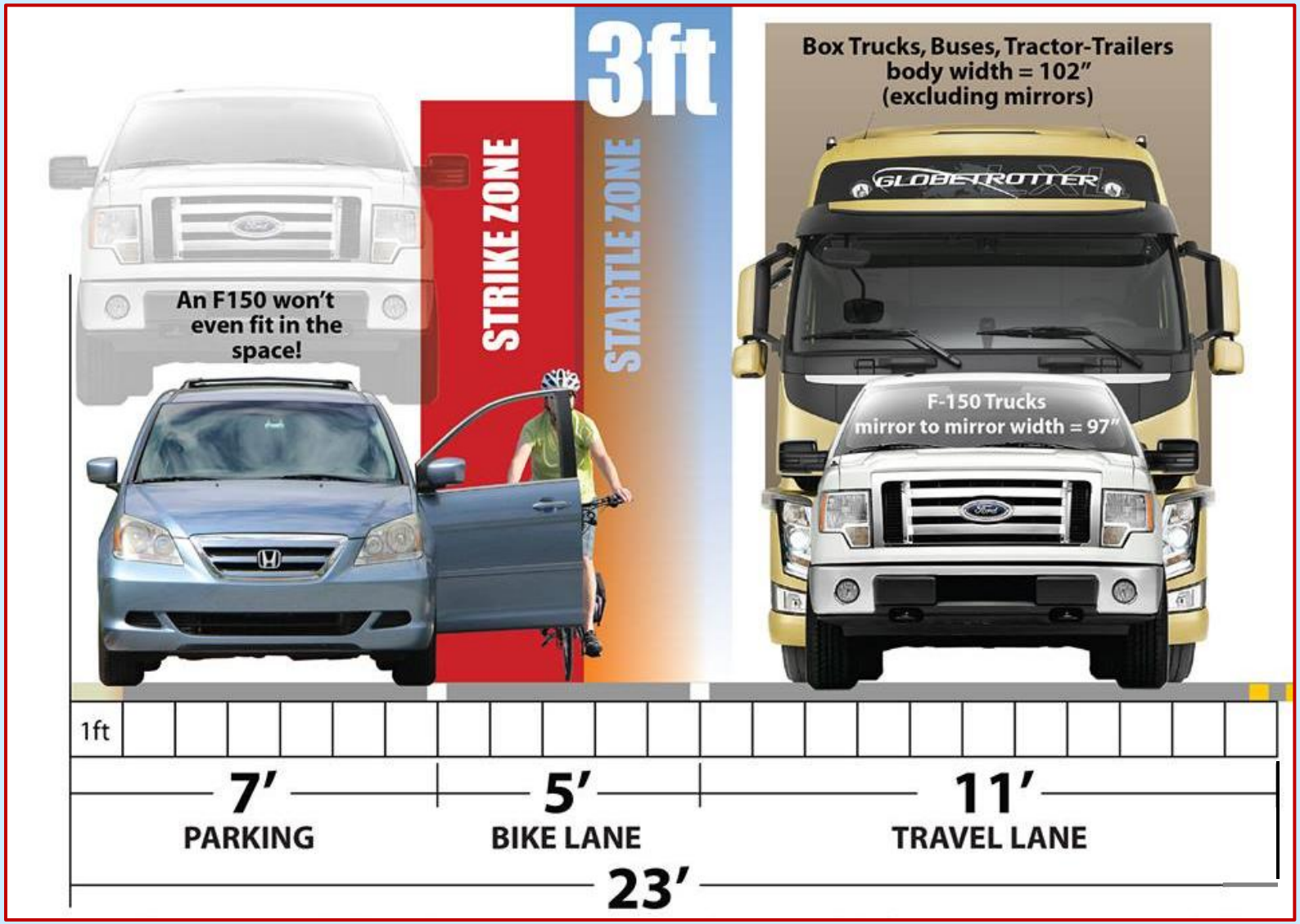


Crossing Crash Avoidance

Source: Understanding Bicycle Transportation Workshop



4. Dooring Crash Risk – 12'/7' Bike Lane



Impossible to avoid door zone in 12/7' bike lane

What is Operating Concept for Door Zone Bike Lane?

Source: Vinny R, English Wikipedia Project

12'/7' Striping Per AASHTO Bike Guide

Operating Concept For Bike Lanes

1. *Design for bicyclists with less confidence/crash avoidance skills.*
2. Apply traffic lane design principles
3. Minimize exposure to hazards:
   - turning, drive out, door zone
   - road surface, debris
4. Induce safe behavior: yielding, merging into bike lane to turn

Photos: Understanding Bicycle Transportation Workshop

Rethinking Bike Lane Design Standards

A. Bike lane crashes we can minimize with an Operating Concept for design

B. Why AASHTO *Bike Guide* and MUTCD bike lane guidance doesn't minimize crashes

C. Bike lane designs that reflect bike lane Operating Concept

AASHTO *Bike Guide* - Bicyclist Operating Space

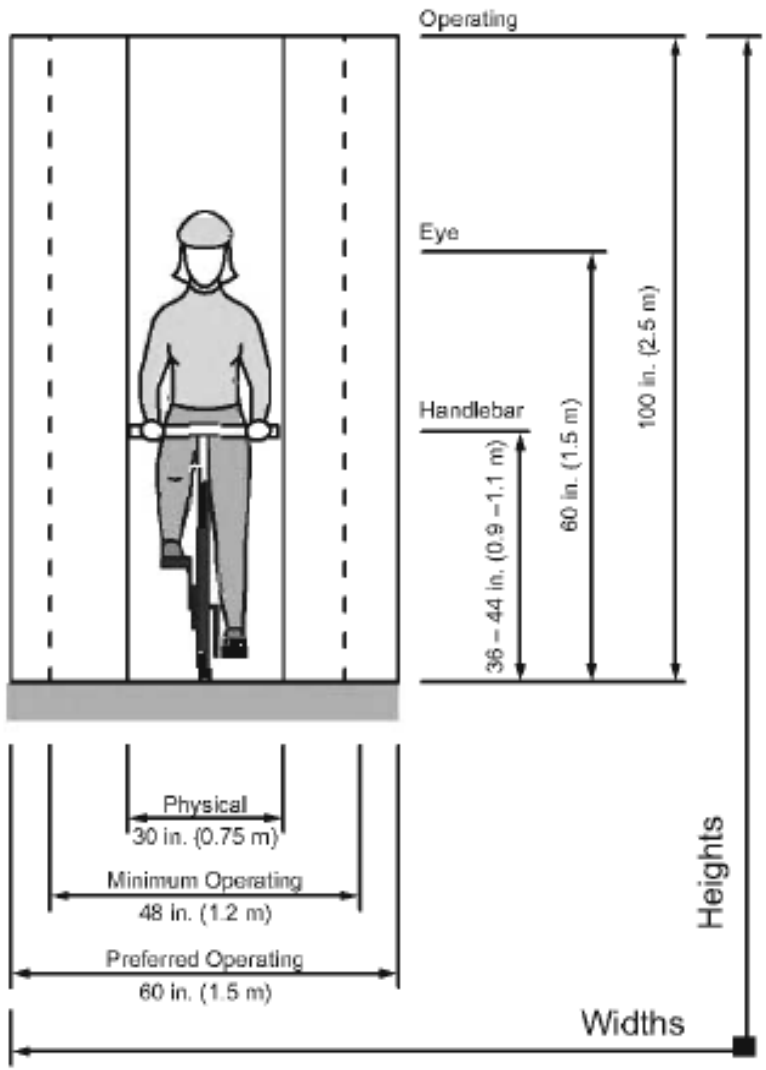


Figure 3-1. Bicyclist Operating Space

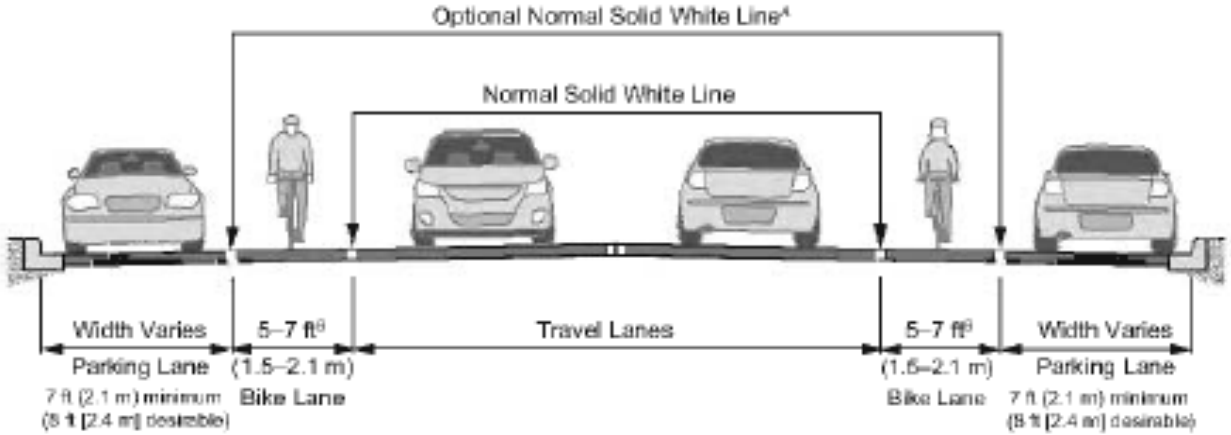
30" Bicyclist Needs 4-5' of Operating Space

Doesn't include clearance – "shy distance" to objects

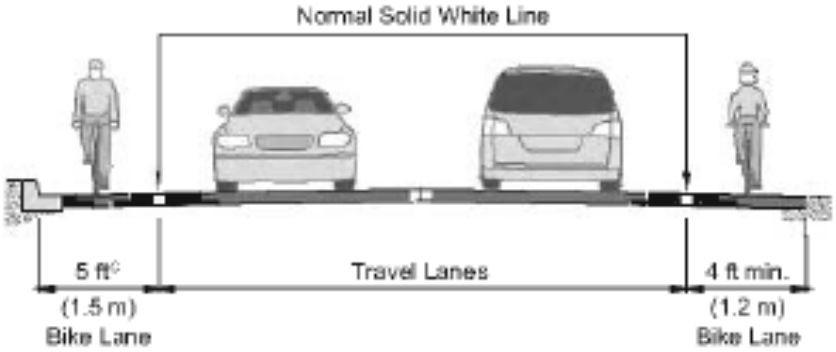
No guidance on clearance to traffic

Source: AASHTO Guide for the Development of Bicycle Facilities 2012 4th Edition

AASHTO 2012 *Bike Guide* – Bike Lane & Parking Width



On Street Parking



Parking Prohibited

Notes:

A An optional normal (4–6-in./100–150-mm) solid white line may be helpful even when no parking stalls are marked (because parking is light), to make the presence of a bicycle lane more evident. Parking stall markings may also be used.

B Bike lanes up to 7 ft (2.1 m) in width may be considered adjacent to narrow parking lanes with high turnover.

C On extremely constrained, low-speed roadways (45 mph [70 km/h] or less) with curbs but no gutter, where the preferred bike lane width cannot be achieved despite narrowing all other travel lanes to their minimum widths, a 4-ft (1.2-m) wide bike lane can be used.

Fig 4-14 Typical Bike Lane Cross Section

AASHTO *Bike Guide* – Bike Lane Shifts Left for RT Lane

scenario is the least preferred option and should be avoided where practicable. In this situation, the "BEGIN RIGHT TURN LANE YIELD TO BIKES" sign should not be used, since bicyclists are the users who need to yield as they are weaving across the path of motor vehicle traffic.

Figure 4-21. Example of Bike Lane with Through Lane Transitioning to Right-Turn-Only Lane

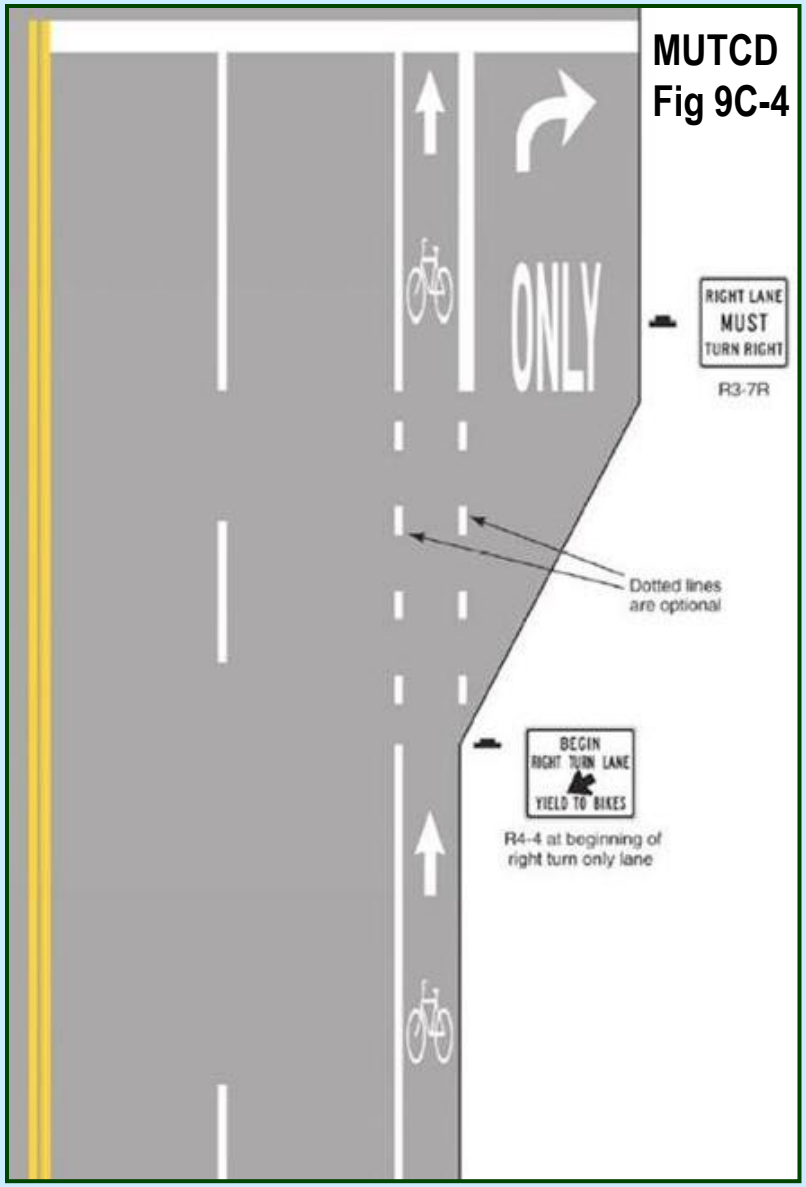
- Is *Bike Guide* Correct?
- Through bicyclists merge left, turning motorists merge right
- Who Should Yield? It's <u>Ambiguous</u>

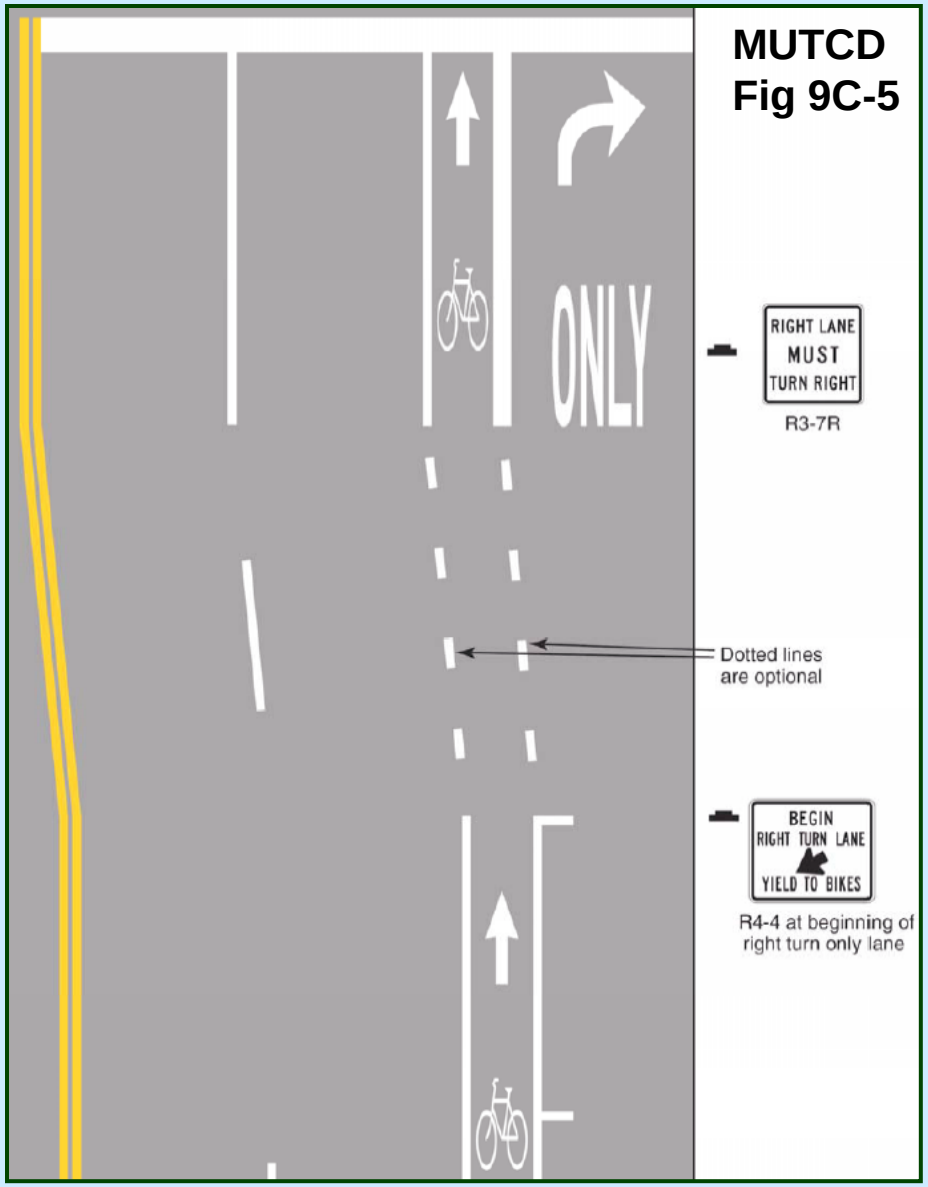
Bike Lane Shifts For Right Turn Lane

Source: Understanding Bicycle Transportation Workshop

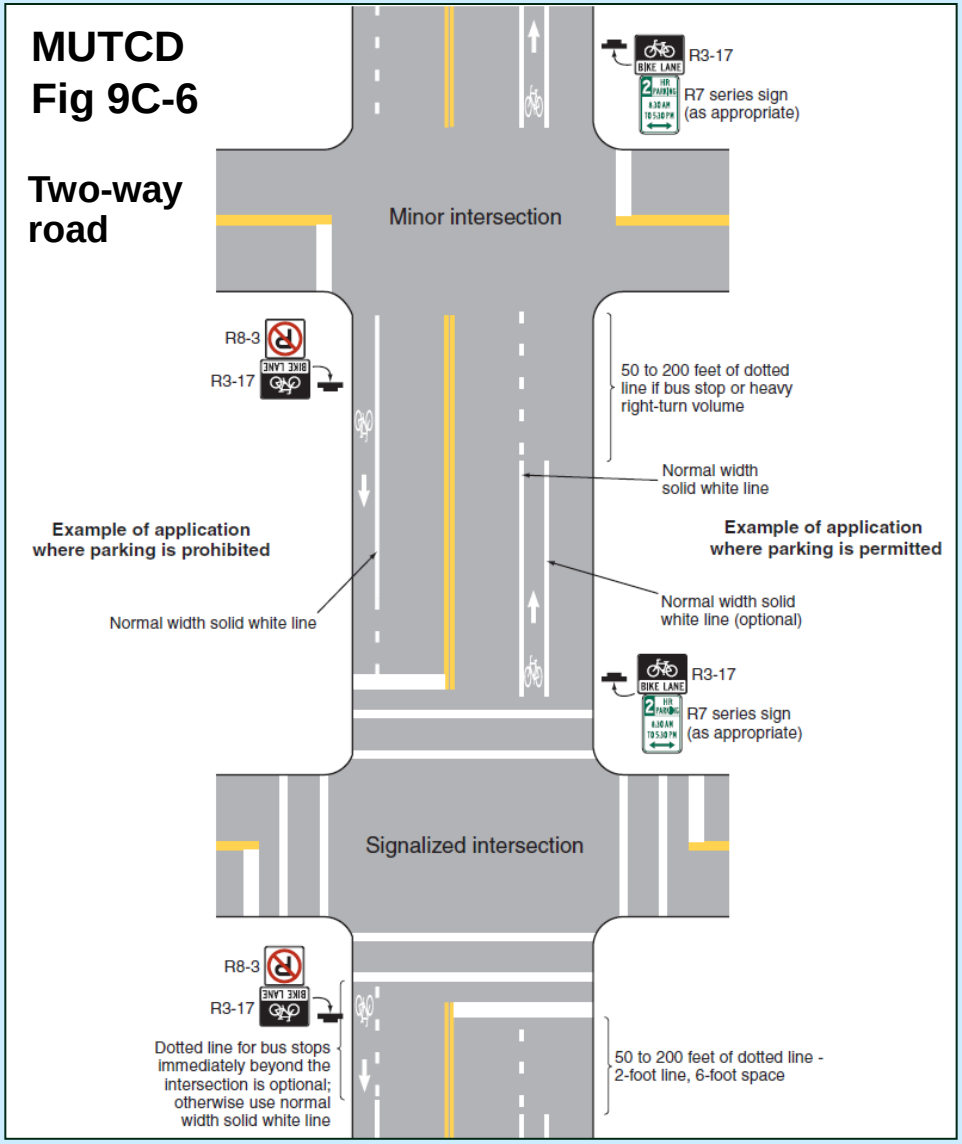
Failed Attempt to Rectify Yielding Ambiguity

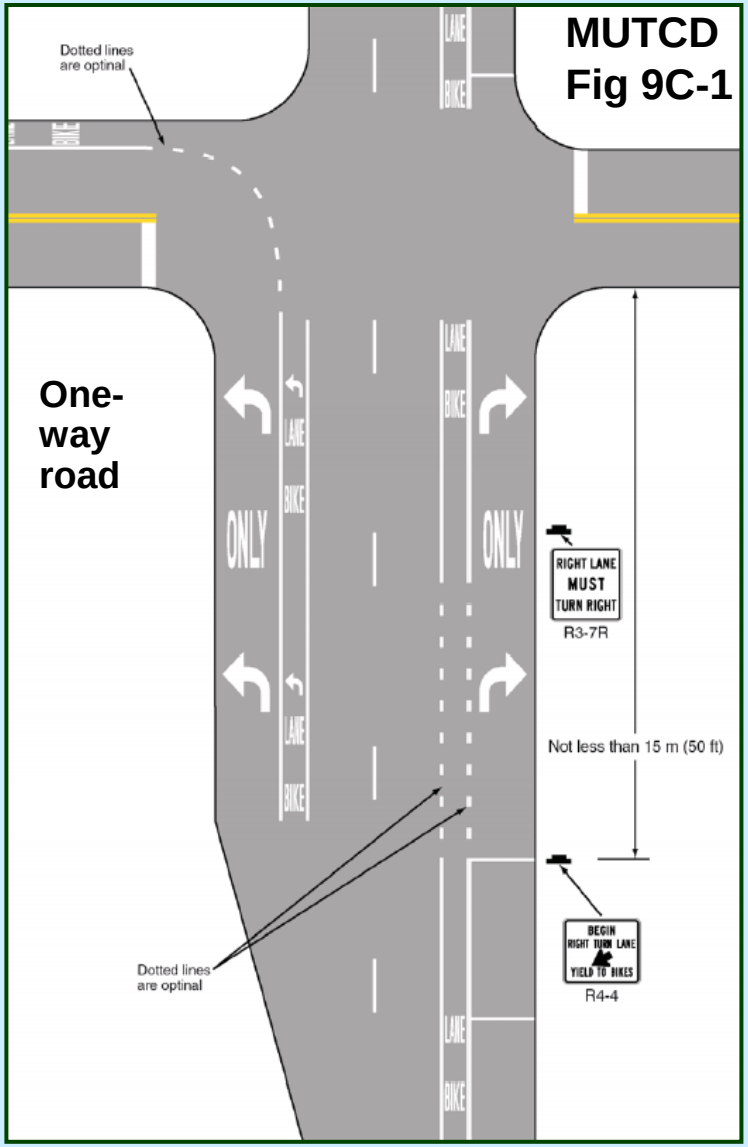
MUTCD - Bike Lane Striping at RTOLs





MUTCD Bike Lane Striping Figures





No Standards or Guidance for Striping or Parking Setback from Corner

Drivers Don’t Enter 6’ Bike Lane Next to Parking

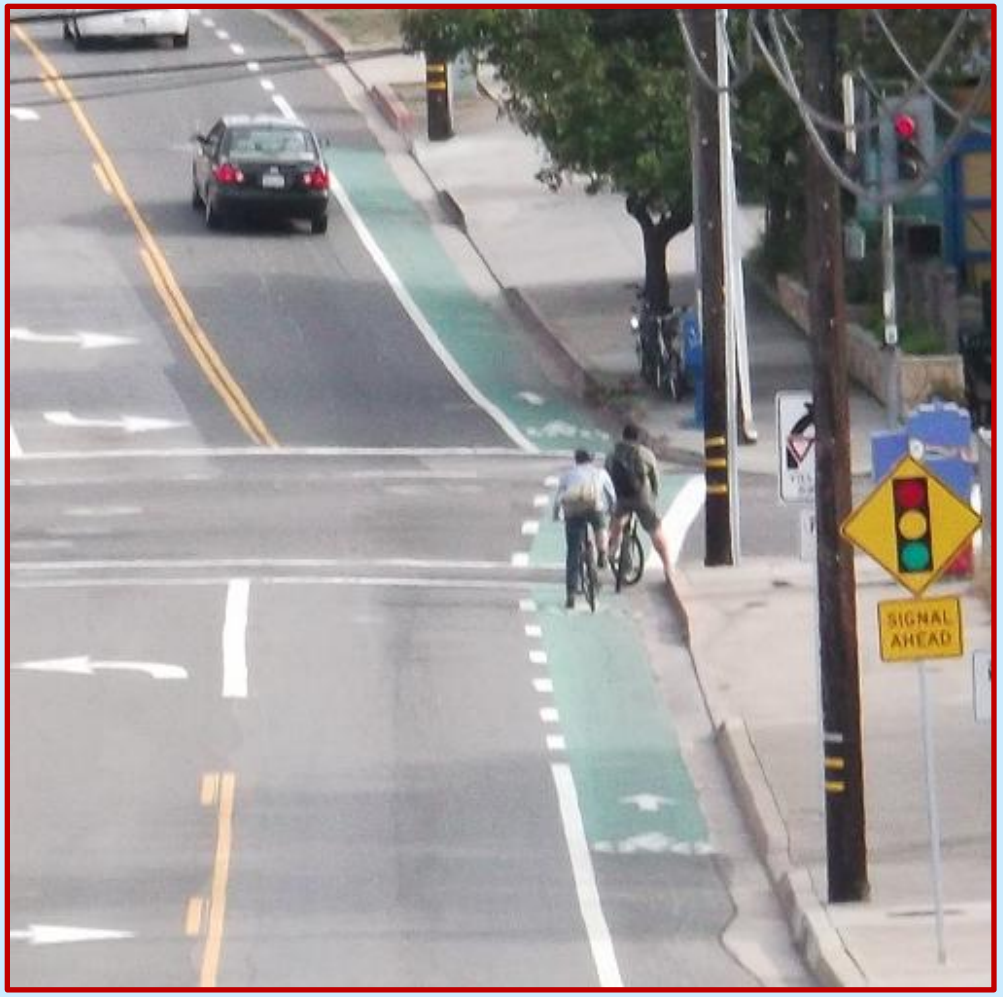
Source: Google Earth

Need MUTCD Guidance for “No Parking” Setback From Corner

Bike Guide/MUTCD Compliant Bike Lane (no parking)

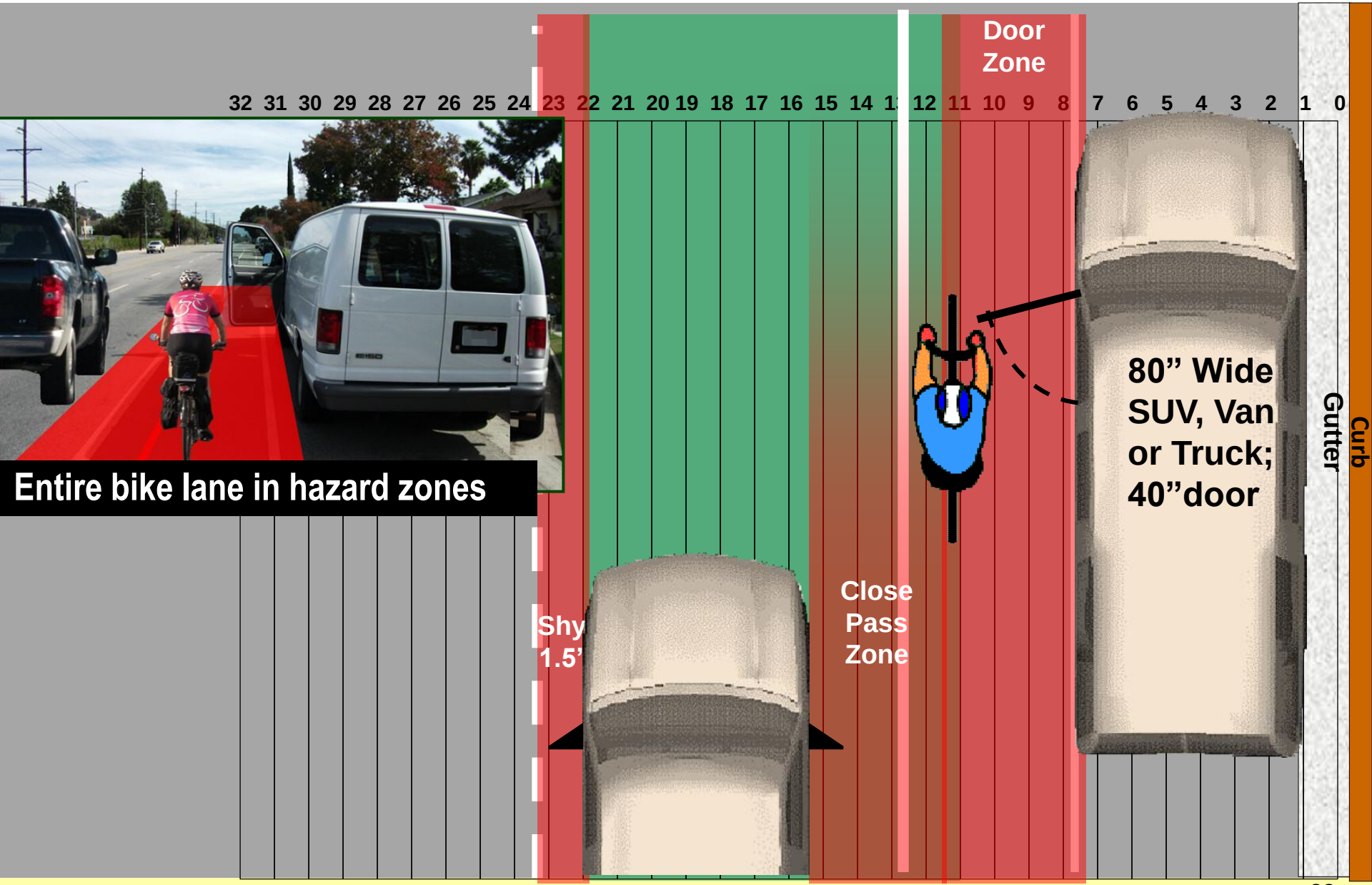
Bike lane encourages cyclist to stay in right hook position

Source: Understanding Bicycle Transportation Workshop



Do drivers recognize narrow bike lane as right turn lane?

Bike Lane Next to Parking - 13/8’ Bike Lane too Narrow



Source: Understanding Bicycle Transportation Workshop

13/7' Bike Lane Per *Bike Guide* Recommendation

Source: Ed Cox


Source: Cyclemoco.com


Source: Cyclemoco.com

- **Is Riding on The Bike Lane Stripe the Operating Concept?**
- **Where Should a Cyclist With a Child Trailer Operate?**

Bike Guide - Recommended "Wider" Bike Lanes

Source: Understanding Bicycle Transportation Workshop

14'/8' Striping

Source: www.labreform.org

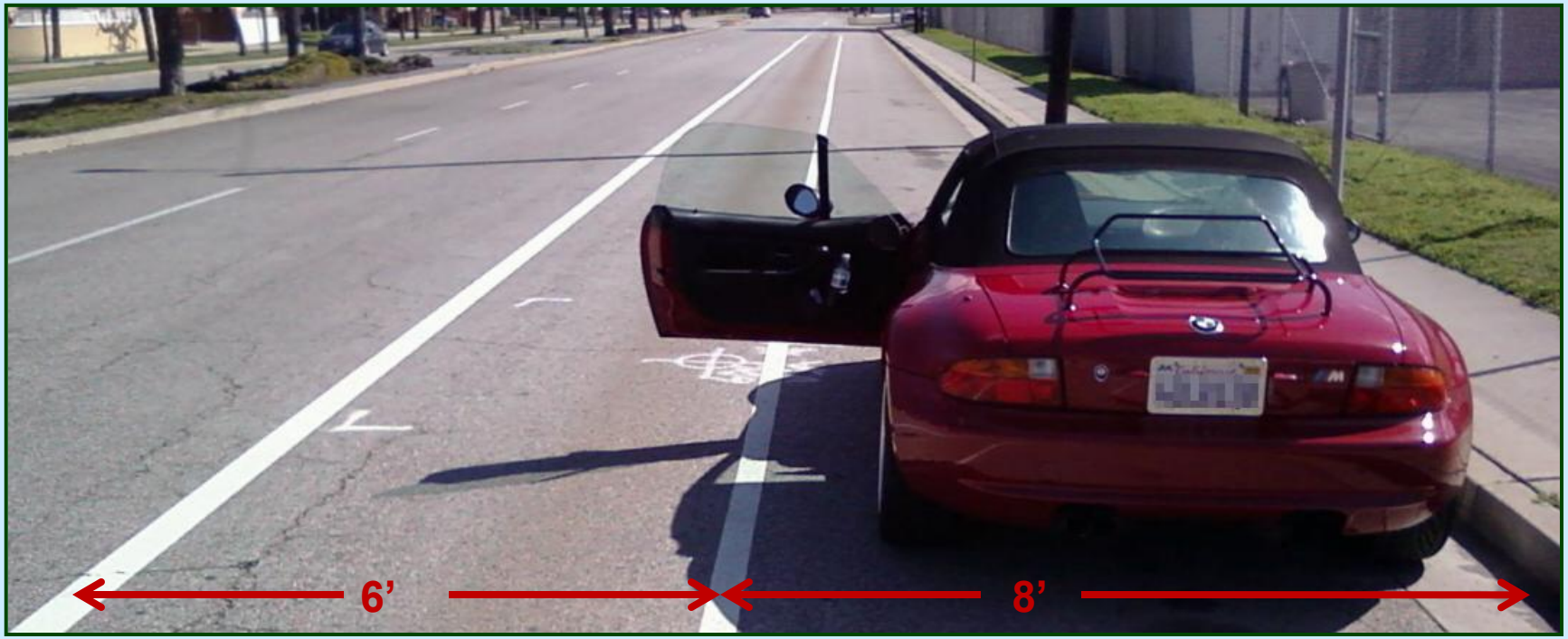
14'/9' Striping

Still Door Zone Bike Lanes

14’/8’ Bike Lane in Door Zone

Same Location, narrow and wider vehicles
1. **Bike Lane stripe 14’ from curb**

Source: Understanding Bicycle Transportation Workshop



Rethinking Bike Lane Design Standards

A. Bike lane crashes we can minimize with an Operating Concept for design

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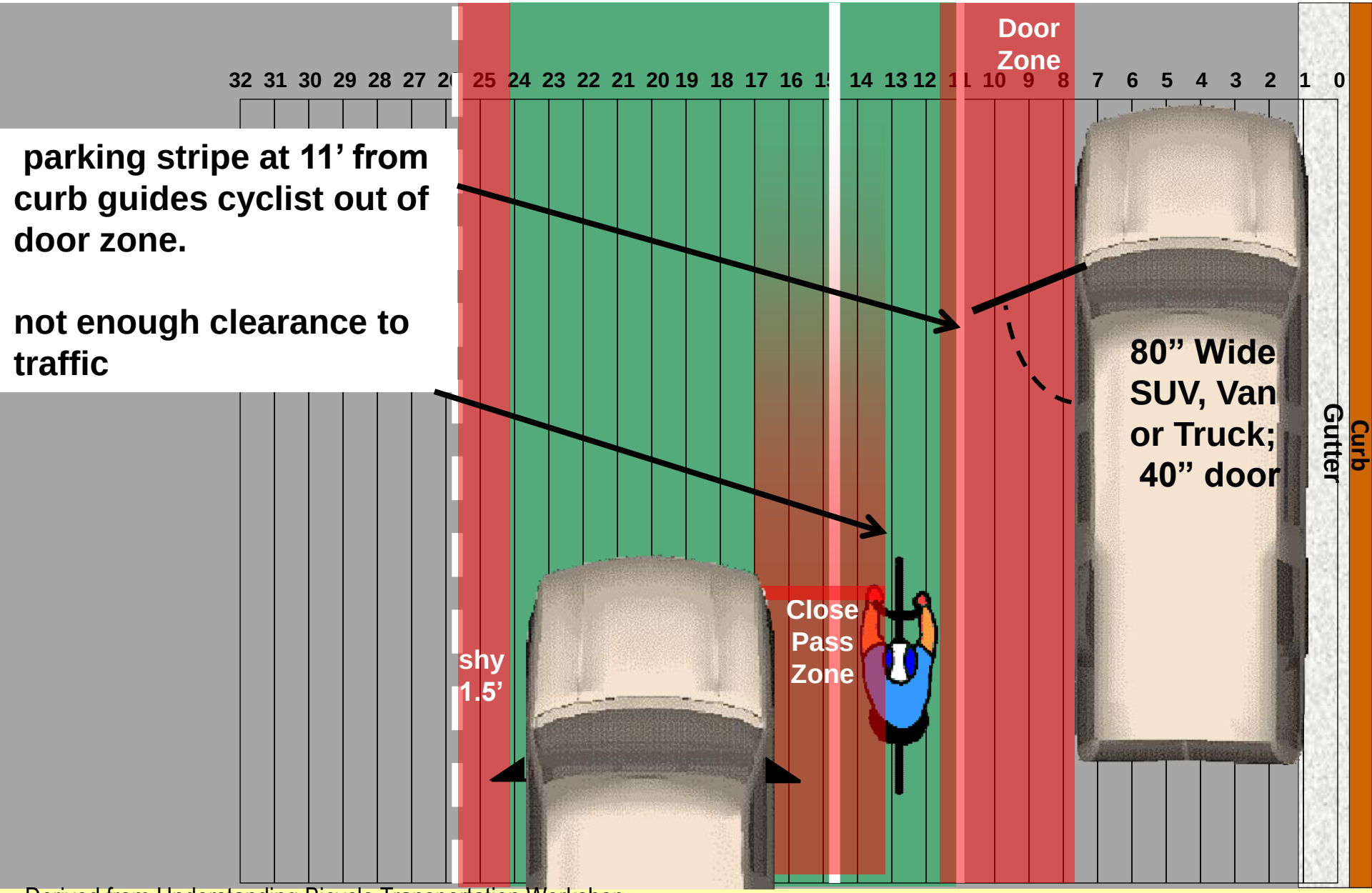
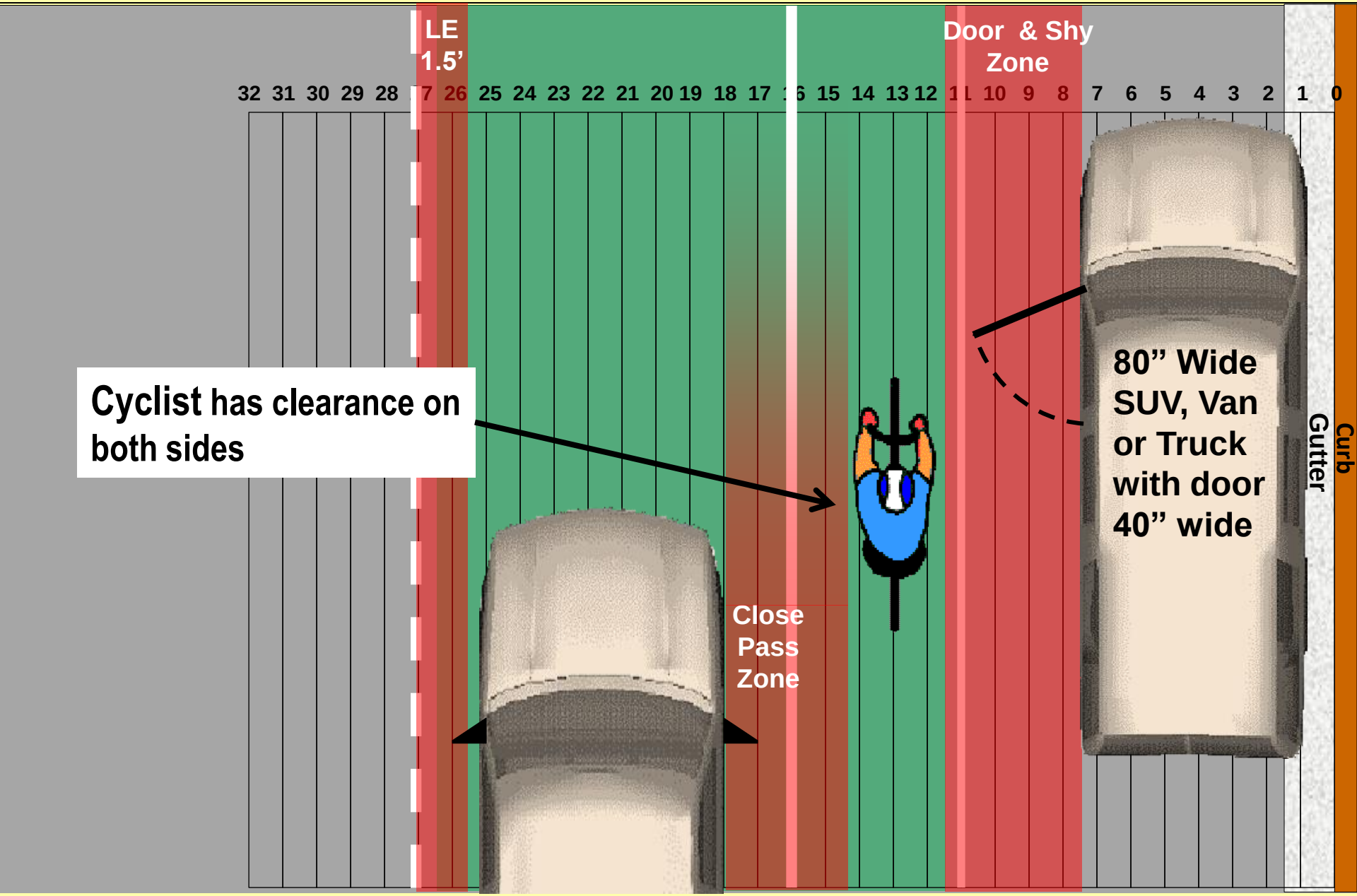
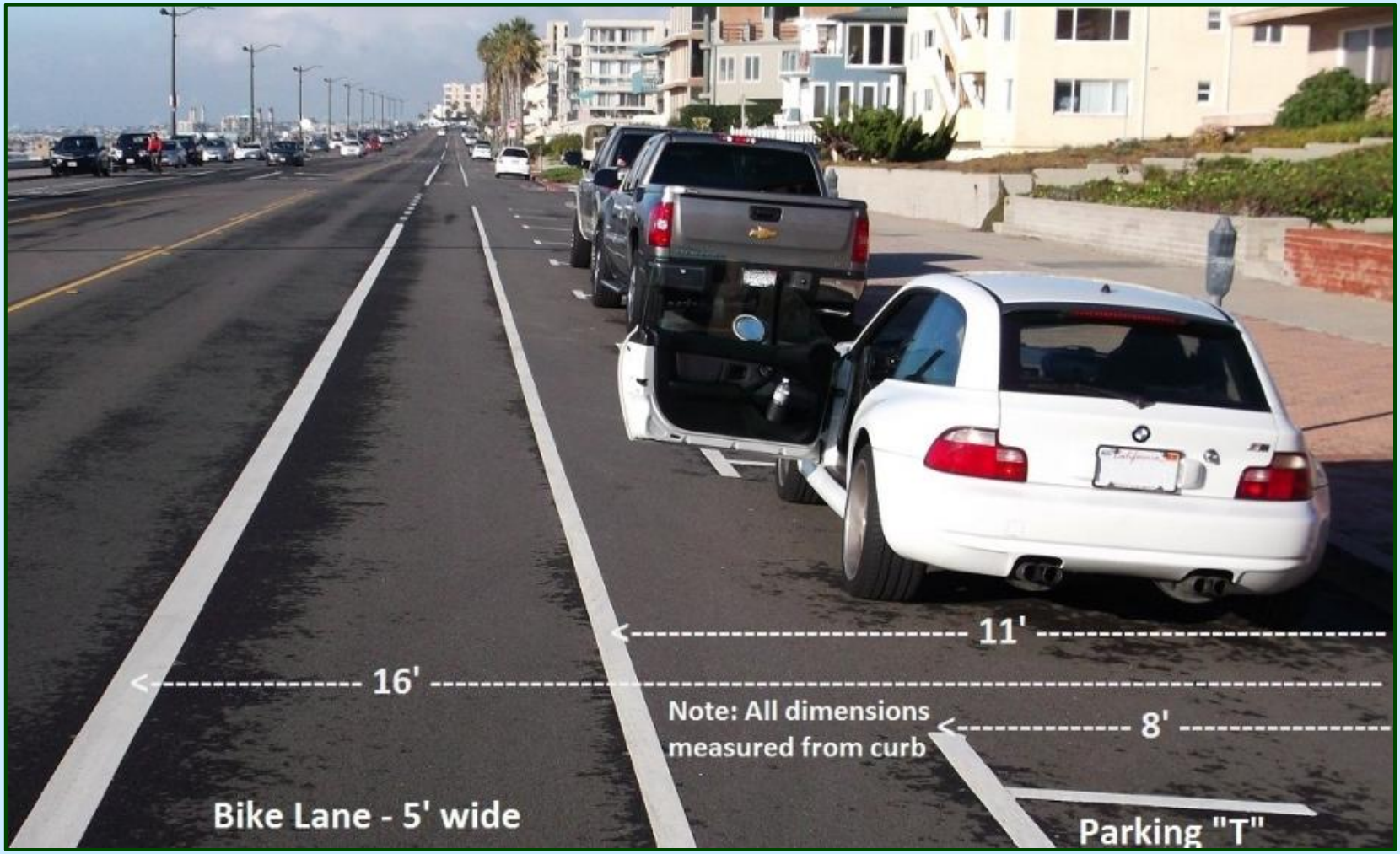
15’/11’ - Out of Door Zone But Not Enough Clearance to Traffic



16’/11’ Should Be The Minimum



16’/11’ Bike Lane Should Be Minimum



Source: Understanding Bicycle Transportation Workshop

Redondo Beach, CA

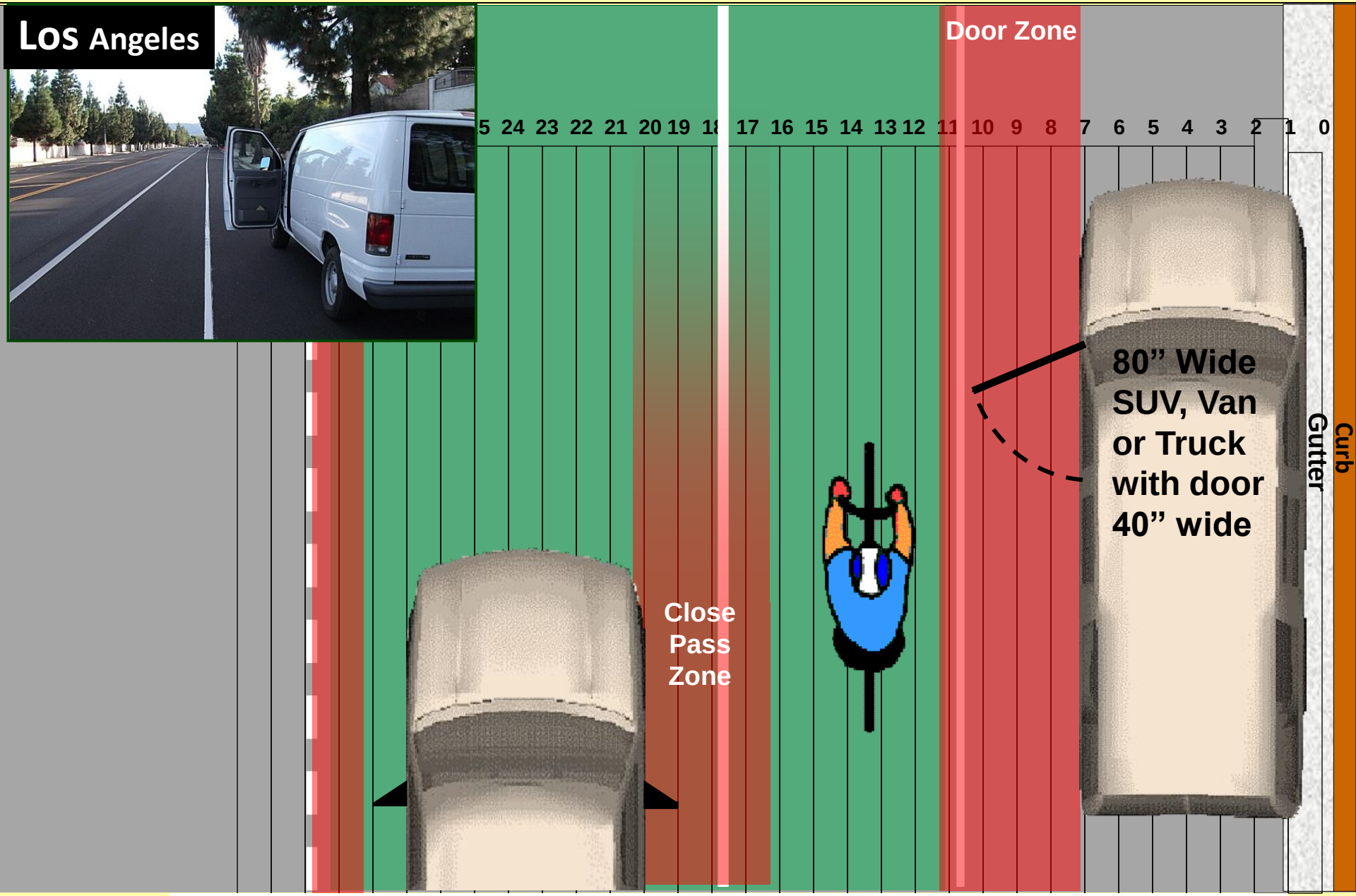
17’/12’ Bike Lane Preferred

Source: Understanding Bicycle Transportation Workshop

Redondo Beach, CA

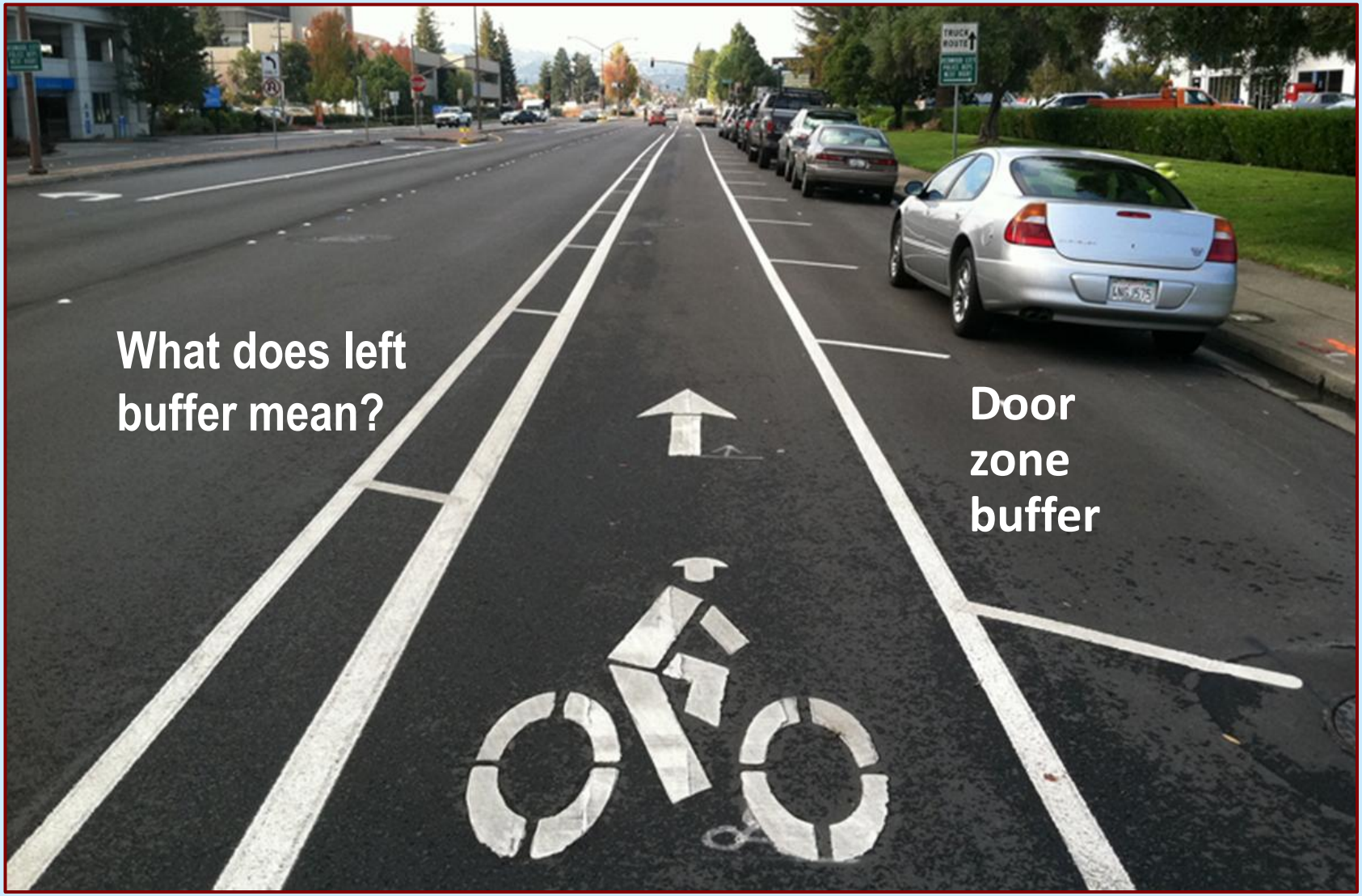
Bicyclist is clear of door zone anywhere in bike lane

18’/11’ ~ 3’Clearance To Traffic Lane, 5’ Operating Space



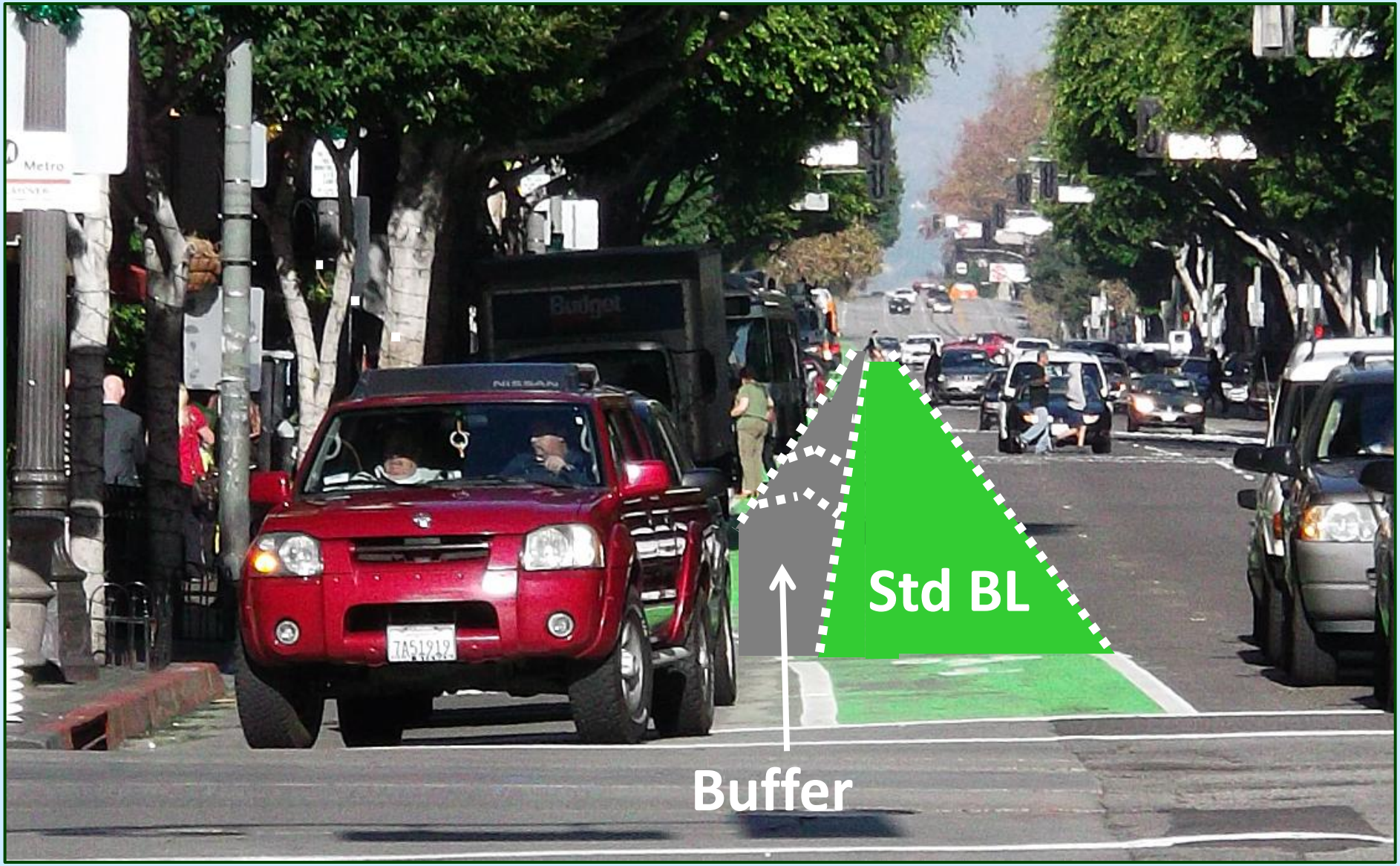
Source: Understanding Bicycle Transportation Workshop

Right Buffer Warns Bicyclist of Dooring Hazard



Source: Understanding Bicycle Transportation Workshop

Move Buffer From Left of Bike Lane to Door Zone



Source: Understanding Bicycle Transportation Workshop

Buffer Increases Turning and Drive Out Crash Risks

Source: Understanding Bicycle Transportation Workshop

- Induces motorist to merge late or turn across cyclist's path
- Induces cyclists to stay far to the right

Curb diving Left Buffered Bikeway

Source: Understanding Bicycle Transportation Workshop

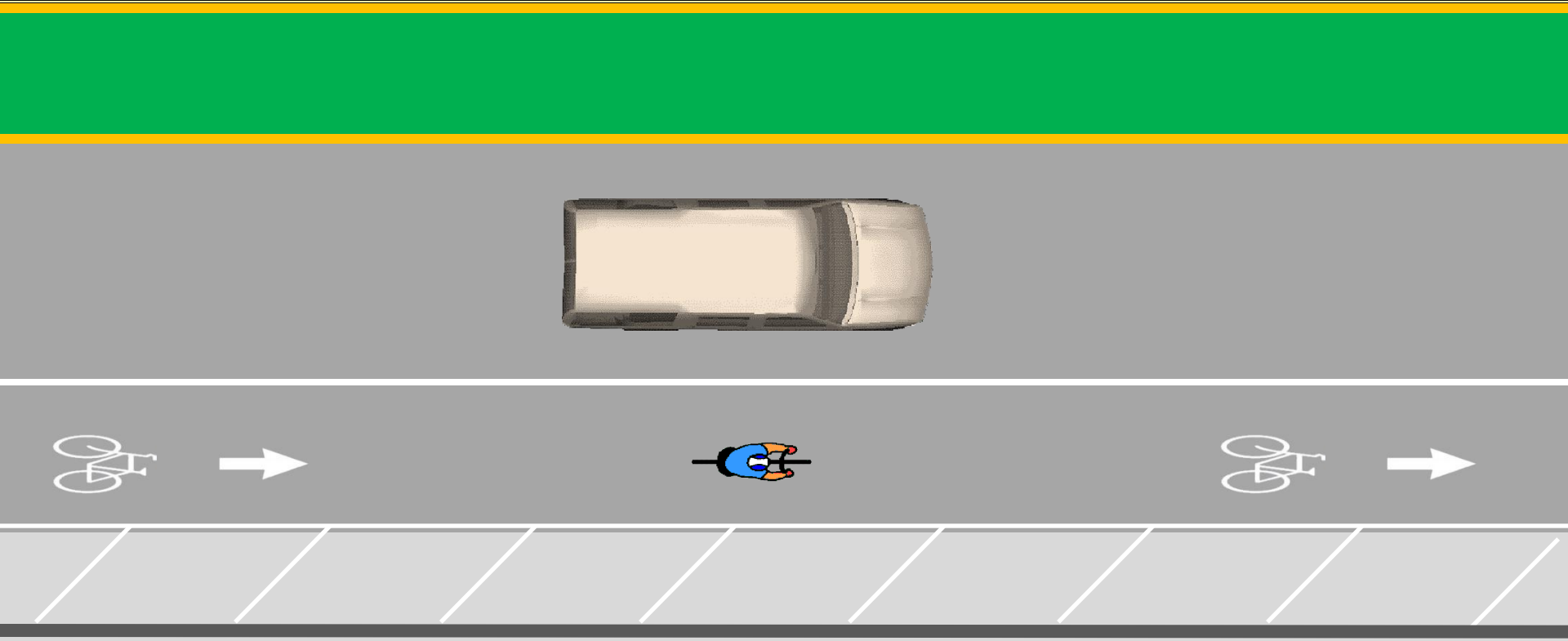
Right Buffer Applies Operating Concept

Source: Understanding Bicycle Transportation Workshop

Right Buffer Instead of Curb Diving Bike Lane

Source: Understanding Bicycle Transportation Workshop

Right Side Buffer - Midblock



Source: Understanding Bicycle Transportation Workshop

- Increases visibility of cyclists
- Brings entire bike lane out of the gutter, away from crash hazards
- Allows cyclist to control clearance to traffic lane

Right Side Buffer - Midblock

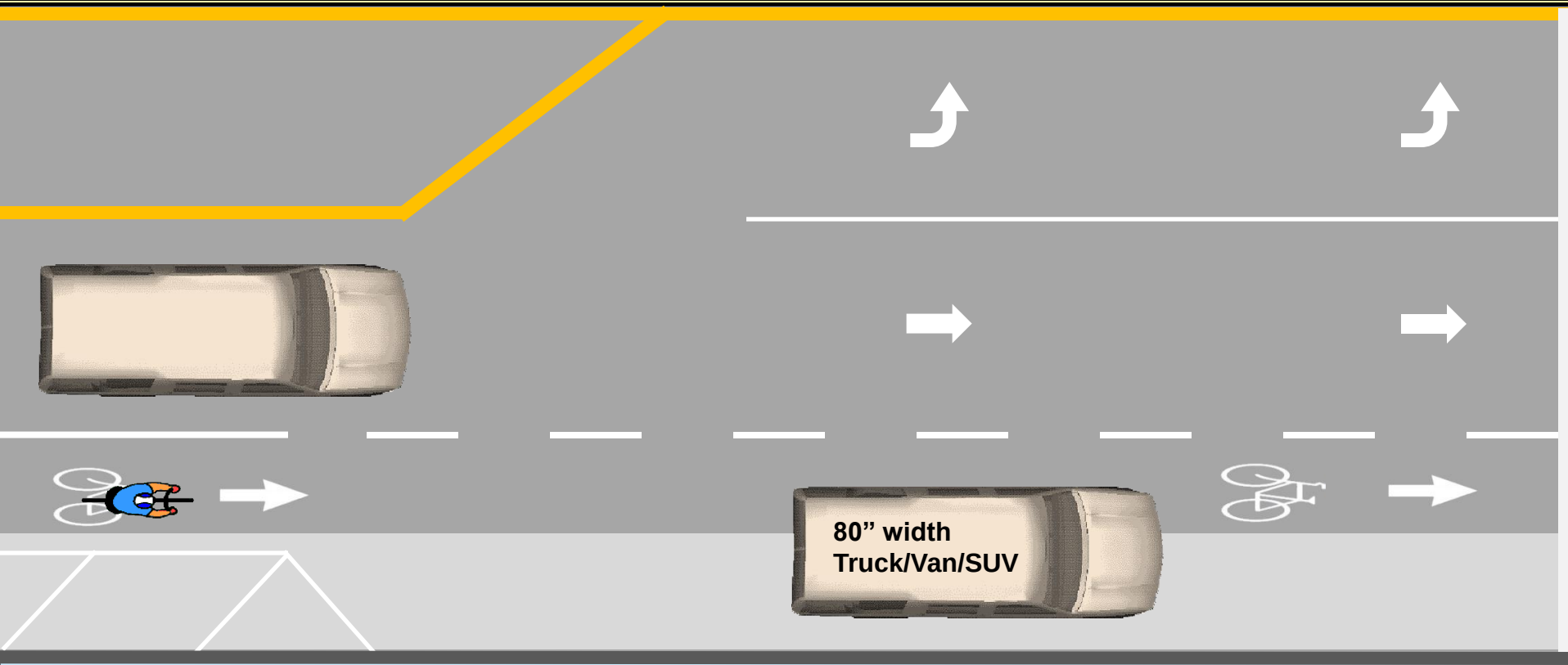
Source: Understanding Bicycle Transportation Workshop

Right Side Buffer - Midblock

Source: Understanding Bicycle Transportation Workshop

4’ buffer is too narrow to mistake for parking lane

Intersection Approach – Right Buffer



- Buffer is dropped for right turns from bike lane
- Bike markings on left to show position for through travel
- Sign needed in MUTCD ?

Source: Understanding Bicycle Transportation Workshop

Dropped Buffer at Intersection Applies Operating Concept

Source: Understanding Bicycle Transportation Workshop

- Encourages merge into BL for right turns
- Adequate clearance from adjacent traffic lane
- Consistent/continuous travel path, aligns with BL on far side
- Minimizes drive out crash risk
- Bicyclist more visible to oncoming left turning traffic

Compare to Dropped Bike Lane For Right Turn Lane

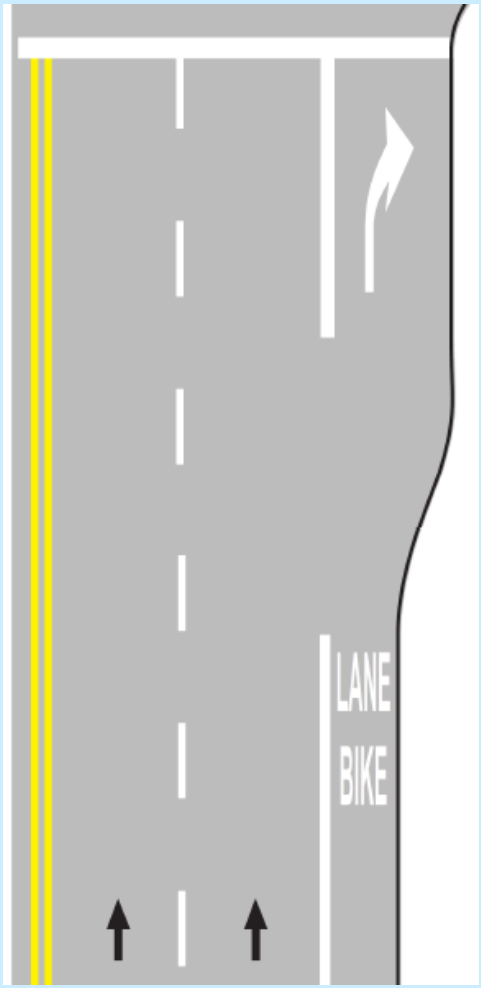
Source: Understanding Bicycle Transportation Workshop

Yielding Ambiguity

Right Buffered Bike Lane – Near Side & Far Side

Source: Understanding Bicycle Transportation Workshop

Compare 3 Intersection Design Options

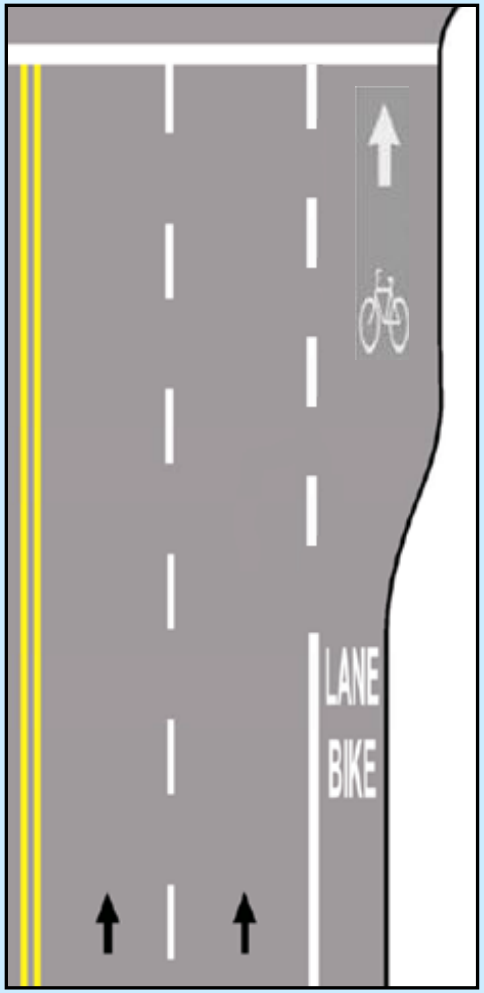


BL drops for RTL

POOR

RTL, exception for through bikes

BETTER



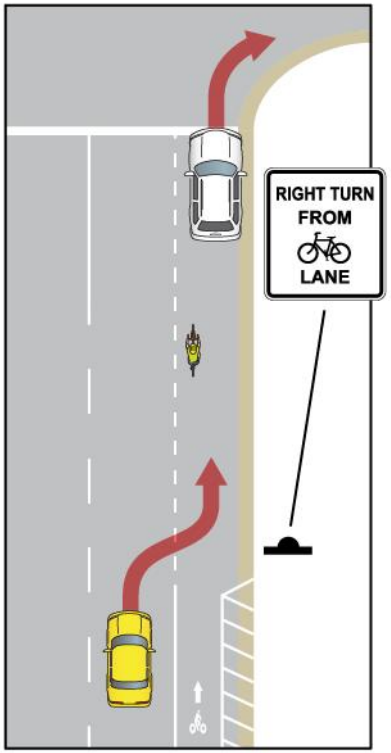
Continuous wide BL

BEST

Wide BL Applies Operating Concept

iamtraffic: Drop Buffer – Use BL for Right Turns

Preferential Use Lane



Buffer discontinued and bike lane line dashed 200ft before an intersection. Right-turning motorists must make turns from the bike lane and yield to bikes.

/iamtrafficorg

A **Preferential Use Lane** is designed with the same consideration given to bus and HOV lanes.

- Must provide adequate operating space and clearance from vehicles in adjacent lanes.
- Must offer the same vantage as the drivers of other vehicles (outside exclusion zone).
- Intersection design must encourage right turning drivers to merge into—not turn across—the lane.

If there is not enough space to do this, then full use of a regular 10-12ft travel lane should be encouraged.

EXAMPLE: SAN PEDRO, CA

Rethinking Bike Lane Design Standards - Summary

A. We can minimize bike lane crashes with Operating Concept for bike lanes

B. Improve AASHTO *Bike Guide* and MUTCD guidance with a sound bike lane Operating Concept

C. You can apply Operating Concept to bike lanes NOW